Records

You will learn in this section of notes how to create a new, composite type, that can be composed of different types of elements.

Tracking Information

Example, storing information about a client:

- First name …array or String
- Last name …array or String
- Phone number …integer, array or String
- Address …array or String
- Postal code …array or String
- Email address …array or String
- Total purchases made …integer or real

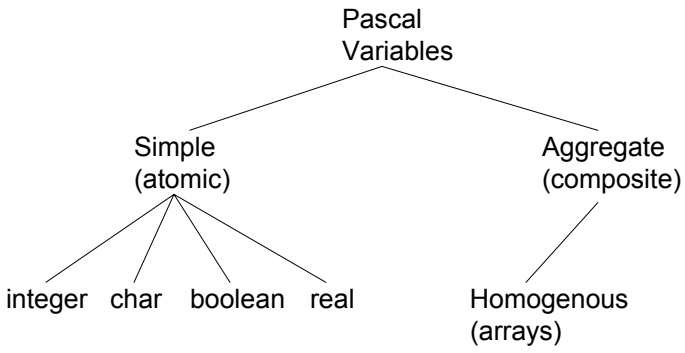
Tracking Information

Problem: information about one client should be treated as one entity in a program (it's composite). The following approach is not reasonable yet an array won't do (the fields of a client are not homogenous, not the same type):

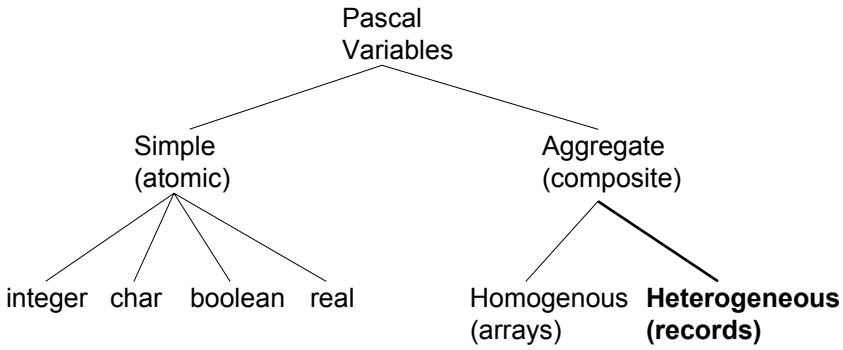
```
procedure initialize (firstName    : String;
                      lastName     : String;
                      phone        : integer;
                      address      : String;
                      postalCode   : String;
                      email        : String;
                      purchases    : real);

begin
   :   :   :
end;
```


Types Of Variables: What You Know



Types Of Variables: What You Will Learn



What Is The Benefit Of Using A Record

It allows new types of variables to be declared.

The variable can be a homogenous composite type:

- All the parts that compose the whole are of the same type

The variable can be a heterogeneous composite type:

- The different parts that compose the whole can be of different types

The new type can model information about most any arbitrary entity:

- Car
- Movie
- Your pet
- Etc.

Declaring Records

Format:

```
type
   Name of record = record
            name of field (1) : type of field (1);
            name of field (2) : type of field (2);
            name of field (3) : type of field (3);
               :    :    :          :    :    :
            name of field (n) : type of field (n);
   end; (* Record declaration *)
```


Declaring Records (2)

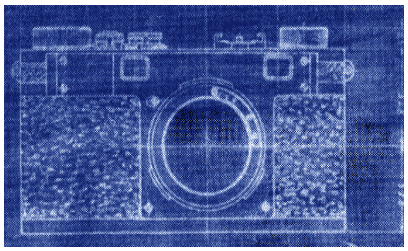
Example:

```
const
  NAME_LENGTH = 16;

type
  Person =  record
            name   : string [NAME_LENGTH];
            age    : integer;
            height : real;
            weight : real;
   end; (* Declaration of Person *)
```

A Record Definition Is Like A Blueprint

- It specifies the format or structure of an example of the record (what attributes will track what information)
- No record is actually created by this definition
- No memory is allocated.



Declaring Variables That Are Records

Format:

name of variable : *name of record*;

Example:

```
var jamesTam     : Person;
var bartSimpson  : Person;
```

Declaring An Instance Of A Record Actually Creates A Record

- Something has now been created.

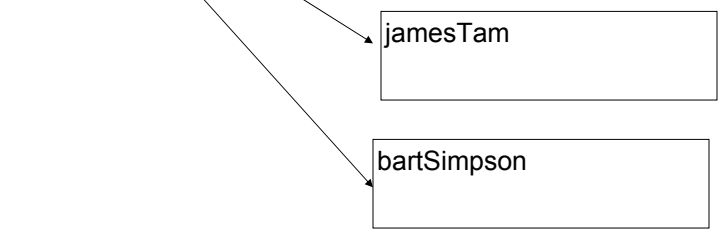
Declaring Variables That Are Records: What You Get

Format:

name of variable : *name of declared record*;

Example:

```
var jamesTam   : Person;
var bartSimpson : Person;
```



Using Record Variables

Example: Declaring the record and instances of the record

```
const
  NAME_LENGTH = 16;

type
  Person =  record
       name   : string [NAME_LENGTH];
       age      : integer;
       height  : real;
       weight : real;
   end; (* Declaration of a Person *)

begin
    var jamesTam      : Person;
    var bartSimpson  : Person;
     :        :                    :
end.
```


Using Record Variables (2)

Assignment (field-by-field basis):

e.g.,

```
bartSimpson.name := 'Bart';
bartSimpson.age := 10;
bartSimpson.height := 48;
bartSimpson.weight :=80;
```

Assignment (entire record, all fields are copied – if the records are declared to be the same type)

e.g.,

```
jamesTam := bartSimpson;
```

Assignment Between Different Record Types Cannot Be Performed

Example:

```
const
  NAME_LENGTH = 80;
type
  Cat =  record
       name : string [NAME_LENGTH];
  end; (* Declaration of a Cat *)

  Dog = record
     name : string [NAME_LENGTH];
  end; (* Declaration of a Dog *)

begin
    var aCat  : Cat;
    var aDog : Dog;
    aCat := aDog;
          :
end.
```

Problem:

- Cat <> Dog
- Each has been declared to be a different type of variable.

Assignment Between The Same Type Of Record Can Be Performed

Example:

```
const
  NAME_LENGTH = 80;
type
  Pet =  record
       name : string [NAME_LENGTH];
  end; (* Declaration of a Pet *)

begin
    var aCat  : Pet;
    var aDog : Pet;
    aCat := aDog;
          :
end.
```

Using Record Variables (3)

- Input and output is via read/readln and write/writeln
- Must be done on a field by field basis (if the field is a type that can be "understood"[1] by read/readln or write/writeln

e.g.,

```
write('Enter name for student : ');
readln(jamesTam.name);

writeln('First name: ', jamesTam.name);
```

1 This includes the built in simple types as well as one dimensional character arrays

Examples Of Accessing The Fields Of A Record

```
type
  Fur = record
      color : array [1..10] of char;
  end; (* Declaration of Fur *)

  Animal = record
      species : array [1..10] of char;
      coat    : Fur;
  end; (* Declaration of Animal *)

begin
  var tigger : Animal;
  readln(tigger);
  readln(tigger.species);
  readln(tigger.coat);
end.
```

A Shortcut For Referencing All The Fields Of A Record: With-Do

- Allows you to refer to the fields of a record without having to constantly refer to the name of the record variable.

Format:

with *name of record variable* do
    body

Example:

```
with bartSimspon do
begin
    writeln('Personal information:');
    writeln('Name: ':8, name);
    writeln('Age: ':8, age);
    writeln('Height: ':8, height);
    writeln('Weight: ':8, weight);
end; (* With do for Bart Simpson *)
```


Passing Records As Parameters

- After a type for the record has been defined, instances of the record may be treated as any type of variable.
- Passing parameters that are records looks like passing other types of parameters.
- Records can be passed as value or variable parameters

Example (procedure call):

```
displayPerson (jamesTam);
```

Example (procedure definition)

```
procedure displayPerson (jamesTam : Person);
begin
        (* Body of the procedure *)
end;  (* Procedure displayStudent *)
```

Putting This All Together

You can find a full version of this program in Unix under:
/home/231/examples/records/person.p

```
program person (input, output);

const
  NAME_LENGTH = 16;

type
  Person =  Record
              name   : string [NAME_LENGTH];
              age    : integer;
              height : real;
              weight : real;
            end; (* Declaration of Person *)
```


Putting This All Together (2)

```
procedure initialize (var bart  : Person;
                      var james : Person);
begin
  writeln;
  writeln('Setting the starting values');
  with bart do
  begin
    write('Name: ');
    readln(name);
    write('Age: ');
    readln(age);
    write('Height: ');
    readln(height);
    write('Weight: ');
    readln(weight);
  end;
  james := bart;
end;
```

Putting This All Together (3)

```
procedure display (bart   : Person;
                   james : Person);
begin
  writeln;
  writeln('BART');
  writeln('Name: ':8, bart.name);
  writeln('Age: ':8, bart.age);
  writeln('Height: ':8, bart.height:0:2);
  writeln('Weight: ':8, bart.weight:0:2);
  writeln;
  writeln('JAMES');
  with james do
  begin
    writeln('Name: ':8, name);
    writeln('Age: ':8, age);
    writeln('Height: ':8, height:0:2);
    writeln('Weight: ':8, weight:0:2);
    writeln;
  end;
end; (* display *)
```


Putting This All Together (4)

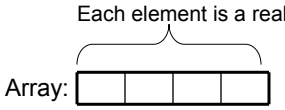
```
begin
  var bart   : Person;
  var james : Person;

  initialize(bart,james);
  display(bart,james);
end.
```

Arrays

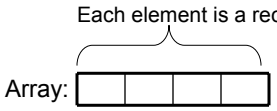
What you know: using arrays to store a collection of simple types:

- For example, an array of real numbers can be used to track the grades in a class.



What you will learn: using arrays to store a collection of composite types:

- For example, an array of records can be used to track a list of clients.



Declaring Arrays Of Records

Method:

1) Declare the record
2) Declare a type for the array of records
3) Declare the array of records

As with arrays of simple types, the second step is essential in Pascal for passing the array as a parameter into functions and procedures!

Declaring Arrays Of Records

```
const
  NAME_LENGTH = 16;
  MAX_PEOPLE    = 10;

type
  Person =  Record
              name   : string [NAME_LENGTH];
              age    : integer;
              height : real;
              weight : real;
            end; (* Declaration of Person *)

  People = array [1..MAX_PEOPLE] of Person;
           :                :                :
var calgaryPeople : People;
```


Declaring Arrays Of Records

```
const
  NAME_LENGTH = 16;
  MAX_PEOPLE    = 10;

type
  Person =  Record
              name   : string [NAME_LENGTH];
              age    : integer;
              height : real;
              weight : real;
            end; (* Declaration of Person *)

  People = array [1..MAX_PEOPLE] of Person;
           :                :                :
var calgaryPeople : People;
```

1. Declaring a new Record

2. Declaring a type for the array of records

3. Declaring a new instance of the type

Passing Arrays Of Records As Parameters

- Looks the same as passing in other types of variables
- Can be passed in as value or variable parameters

Example (procedure call):

```
display (calgaryPeople, noPeople);
```

Example (procedure definition)

```
procedure display (calgaryPeople : People;
                   noPeople      : integer);
begin
    (* Body of the procedure *)
end; (* Procedure display *)
```


Putting This All Together

You can find a full version of this program in Unix under:
/home/231/examples/records/person2.p

```
program person2 (input, output);
const
  NAME_LENGTH      = 16;
  MAX_PEOPLE       = 10;
  FILE_NAME_LENGTH = 256;
type
  Person =  Record
              name   : string [NAME_LENGTH];
              age    : integer;
              height : real;
              weight : real;
            end; (* Declaration of Person *)
  People = array [1..MAX_PEOPLE] of Person;
```

Putting This All Together (2)

```
procedure displayMenu;
begin
  writeln;
  writeln('Select method to set starting values for the people');
  writeln('Enter “f" to read the values in from a file');
  writeln('Enter “m" to manually enter in the values yourself');
  write('Enter your choice: ');
end;
```


Putting This All Together (3)

```
procedure manualInitialization (var calgaryPeople : People;
                                var noPeople      : integer);
begin
  for noPeople := 1 to MAX_PEOPLE do
  begin
    with calgaryPeople[noPeople] do
```

Putting This All Together (4)

```
  begin
      write('Enter name of person: ');
      readln(name);
      write('Enter age of person in whole years: ');
      readln(age);
      write('Enter the height of the person in inches: ');
      readln(height);
      write('Enter the weight of the person in pounds: ');
      readln(weight);
      writeln;
    end; (* With-do *)
  end; (* Initialization for-loop *)
end; (* manualInitialization *)
```


Putting This All Together (5)

```
procedure fileInitialization (var calgaryPeople : People;
                              var noPeople      : integer);
var
  peopleValues : text;
  i            : integer;
  fileName     : string[FILE_NAME_LENGTH];
begin
  write('Enter name of input file: ');
  readln(filename);
  reset(peopleValues,filename);
  writeln('Reading initial values from file ', filename);
  if EOF (peopleValues) then
  begin
    noPeople := 0;
    writeln('File ', filename, ' is empty, nothing to read.');
  end
```

Putting This All Together (6)

```
  else
  begin
    noPeople := 0;
    while NOT EOF (peopleValues) AND (noPeople < MAX_PEOPLE) do
    begin
      noPeople := noPeople + 1;
      with calgaryPeople[noPeople] do
      begin
        readln(peopleValues,name);
        readln(peopleValues,age);
        readln(peopleValues,height);
        readln(peopleValues,weight);
        readln(peopleValues);
      end; (* With-do *)
    end; (* readLoop *)
  end; (* else *)
  close(peopleValues);
end; (* fileInitialization *)
```


Putting This All Together (7)

```
procedure display (calgaryPeople : People;
                   noPeople      : integer);
var
  i : integer;
begin
  writeln;
  for i := 1 to noPeople do
  begin
    with calgaryPeople[i] do
    begin
      writeln;
      writeln('Name: ', name);
      writeln('Age: ', age);
      writeln('Height: ', height:0:2);
      writeln('Weight: ', weight:0:2);
    end; (* With-do *)
  end; (* Display for-loop *)
  writeln;
end; (* display *)
```

Putting This All Together (8)

```
procedure handleMenuSelection (initializationMethod : char);
var
  calgaryPeople : People;
  noPeople      : integer;
begin
```


Putting This All Together (9)

```
    case (initializationMethod) of
     'F', 'f' :
    begin
      fileInitialization(calgaryPeople,noPeople);
      display(calgaryPeople,noPeople);
    end;

    'M', 'm' :
    begin
      manualInitialization(calgaryPeople,noPeople);
      display(calgaryPeople,noPeople);
    end;

    else
    begin
      writeln('Your choice was not one of the available options.');
      writeln('Restart program and select again.');
    end; (* otherwise *)
  end; (* case *)
end; (* handleMenuSelection *)
```

Putting This All Together (10)

```
(******************** Start of main program*************************)
begin
  var initializationMethod : char;

  displayMenu;
  readln(initializationMethod);
  writeln;
  handleMenuSelection(initializationMethod);
  writeln;
end.  (* End of main program *)
```


You Should Now Know

- How to declare a record
- How to declare instances of records
- The difference between accessing an entire record and individual fields of a record and how each approach is done in Pascal
- How to work with arrays of records
  - How to declare an array of records
  - How to access individual array elements
  - Passing arrays of records as parameters
- How to use the with-do construct